1976

Silvicultural prescription for the Napa Special Management Unit on the Swan River State Forest

Anthony James Lukes
The University of Montana

A SILVICULTURAL PRESCRIPTION FOR THE NAPA SPECIAL MANAGEMENT UNIT ON THE SWAN RIVER STATE FOREST

by

Anthony James Lukes, Jr.
B.S., University of Montana, 1965

Presented in partial fulfillment of the

requirements for the degree of

Master of Forestry

UNIVERSITY OF MONTANA

1976

Approved by:

George M. Blake
Chairman, Board of Examiners

John B. Stewart
Dean, Graduate School

June 4, 1976
Date

ProQuest LLC.
789 East Eisenhower Parkway
P.O. Box 1346
Ann Arbor, MI 48106 - 1346

ACKNOWLEDGEMENTS

For their help in developing this paper, and serving as members of my graduate committee, I would like to specifically thank Dr. George M. Blake, Dr. David Alt, and Mr. Raymond Shearer. For their special help and assistance in my graduate program, I would also like to thank Dr. George M. Blake, Dr. Thomas J. Nimlos, and Dr. Mark J. Behan.

Over the past ten years so many people have helped and encouraged me to complete my graduate program that the space available here is not sufficient to individually acknowledge these many contributions. I am deeply grateful for those who cared and assisted in so many ways to help me achieve this long sought after goal.

Finally, this paper would not have been written without the continuing love, understanding, and devotion of my wife, Sharon, and her continuing assistance and encouragement is gratefully acknowledged.

TABLE OF CONTENTS

ACKNOWLEDGEMENTS ii

LIST OF TABLES vi

LIST OF ILLUSTRATIONS vii

CHAPTER

I INTRODUCTION 1

II MANAGEMENT DIRECTION

GENERAL MANAGEMENT DIRECTION FOR CLASSIFIED STATE FOREST LANDS 3

SPECIFIC MANAGEMENT DIRECTION FOR THE SWAN RIVER STATE FOREST 7

MANAGEMENT RESOURCES AVAILABLE TO IMPLEMENT CULTURAL TREATMENTS 8

PRESENT MANAGEMENT RESOURCES
FUTURE MANAGEMENT RESOURCES 9

III STAND DESCRIPTION

LOCATION 10

THE PHYSICAL ENVIRONMENT 10

Topography 10
Geology and Soils 12
Climate 15
Watershed 16

MANAGEMENT HISTORY 19

Stand Establishment & Cultural Practices 19
Fire 25
Range 26
Recreation & Aesthetics 27

PRESENT STAND CONDITIONS 28

Statistical Data on the Present Stand 28
Stand Dynamics 30
Habitat Types 32
Insects and Disease 33
Wildlife and Fisheries 35
Genetic Potential 36

IV MANAGEMENT CONSIDERATIONS

SPECIAL CONSTRAINTS APPLYING TO NAPA SPECIAL MANAGEMENT UNIT 39

MANAGEMENT ALTERNATIVES 41

Manage Without Additional Cultural Treatments 41
Manage to Favor Specific Forest Resources 41

Wood Products 43
Recreation and Aesthetics 43
Wildlife 44
Grazing 45
Watershed 46
Manage to Increase Stand Diversity 47
Manage for Genetic Improvement 47

V STAND PRESCRIPTION

Cultural Treatments During the Rotation 49

Management Actions in Adjacent Stands 51
Intermediate Stand Treatments 52
Final Harvest & Regeneration Cuttings 57

MANAGEMENT & SILVICULTURAL CONSIDERATIONS OVER THE MANAGED LIFE OF THE STAND 59

Stand Examinations & Records 59
Stand Protection 60

	Cultural Treatments & Timber Harvest	60
	Slash Disposal & Fire Protection	61
	Recreation & Related Activities	62
	Wildlife	63
	Insects and Disease	64
	Atmospheric Agents	67
VI	IMPACTS OF THE PRESCRIPTION	
	BIOLOGICAL AND ECOLOGICAL	68
	Vegetation	69
	Soil	71
	Wildlife and Domestic Animals	73
	Watershed	73
	SOCIAL	74
	FOREST PRODUCT YIELDS	75
	ECONOMIC	79
VII	CONCLUSION	83

LIST OF TABLES

TABLE		PAGE
1	SOIL CHARACTERISTICS WITHIN THE STAND WHICH ARE IMPORTANT TO MANAGEMENT	14
2	DISCHARGE AND WATER QUALITY MEASUREMENT FROM THE SOUP CREEK HYDROLOGIC STATION	17
3	MERCHANTABLE VOLUME BY SPECIES HARVESTED FROM THE NAPA BURN SALE IN BOARD FEET	22
4	ARTIFICIAL REFORESTATION EFFORTS IN THE STAND BY YEAR, METHOD, AREA, SPECIES AND ACREAGE	24
5	STATISTICAL SUMMARY OF STAND EXAMINATION	29
6	SUMMARY OF PRESCRIBED MANAGEMENT ACTIONS OVER THE LIFE OF THE STAND	50
7	MAJOR INSECT ENEMIES OF THE STAND	65
8	MAJOR FOREST DISEASES THAT MAY DAMAGE THE STAND	66
9	ESTIMATED YIELDS FROM THE STAND AT VARIOUS DEGREES OF STOCKING	77
10	ESTIMATED TOTAL CUBIC FOOT YIELD OF WOOD DURING THE PRESCRIPTION PERIOD	80
11	YIELDS, COSTS, INCOME AND PRESENT VALUES OF THE PRESCRIPTION FOR AN ACRE RECEIVING ALL TREATMENTS	82

LIST OF ILLUSTRATIONS

FIGURE		PAGE
1	AERIAL PHOTOGRAPH OF THE NAPA SPECIAL MANAGEMENT UNIT	11
2	MAP OF THE NAPA SPECIAL MANAGEMENT UNIT SHOWING TREATMENT AREAS WITHIN THE STAND AND THE LOCATION OF STAND ANALYSIS PLOTS	21
3	COMPARISON OF THE PRESCRIBED THINNING SCHEDULED WITH THE U.S. FOREST SERVICE GUIDELINES FOR THE MANAGEMENT OF WESTERN LARCH	76a

CHAPTER I

INTRODUCTION

The intensification of forest management activities in the Northern Rocky Mountains has generated the need for more detailed and comprehensive forest management prescriptions to guide the long-term management of individual forest stands. Basically, a stand management prescription is a silvicultural prescription consisting of a diagnosis of existing stand conditions and a prognosis of stand development over the managed life of the stand under a defined set of management assumptions.

As might be expected, the overall management needs of the individual land management agency or organization dictate both the scope and depth of specific stand management prescriptions. Like many, many land management agencies, the Montana Division of Forestry is attempting to prepare detailed stand management prescriptions on individual stands and to evaluate the degree to which these prescriptions result in improved short and long-term management decisions. The ultimate goal of these efforts is to develop a management system which schedules needed management treatments through the life of the stand, identifies and evaluates significant problems and permits all day-to-day management actions to be directed toward

the goals established within the management prescription.

To evaluate the application of the prescriptive technique to the management of State-owned school trust lands in Montana, the following silvicultural prescription was prepared on the Napa Special Management Unit which is located on the Swan River State Forest. More specifically, the stand is located in Sections 33 and 34, T24N-R17W approximately 9.5 air miles southeast from the town of Swan Lake, Montana. This stand was selected for the preparation of a detailed silvicultural prescription because it is typical of those State-owned forest lands which are highly productive of a variety of resource values and on which significant resource decisions have yet to be made.

CHAPTER II

MANAGEMENT DIRECTION

GENERAL MANAGEMENT DIRECTION FOR CLASSIFIED STATE FOREST LANDS

All State-owned school trust lands granted to the State of Montana under the Enabling Act of 1889 were placed under the responsibility of the State Board of Land Commissioners which is the governing Board of the Department of State Lands. The State Board of Land Commissioners designated by State law as trustees of these lands are the Governor, the Superintendent of Public Instruction, the Attorney General, the Secretary of State and the State Auditor.

By State Law, lands classified as being principally valuable for the growing of timber or watershed protection are designated classified forest land and are placed under the management of the Department of Natural Resources and Conservation's Division of Forestry.[1]

As a result, all recommendations for proposed management actions originate with the Division of Forestry and must receive the approval of both the Board of Natural Resources and Conservation and the Board of State Land

---

[1] Sections 81-302 and 81-1411 of the Revised Codes of Montana 1947

Commissioners.

Seven State Forests have been established in Montana where the concentration of classified State Forest Land facilitates coordinated management of these lands on a unit basis.[2] The stand which makes up the Napa Special Management Unit is located within the boundaries of the Swan River State Forest. Due to the extensive State ownership around the boundaries of the stand, management actions of other landowners in the area have little direct influence on short and long-term management activities.

The fact that this stand is located on school trust lands, that it is designated as Classified State Forest Land, and that it is within the boundaries of a State Forest, means that a variety of Federal and State laws and administrative rulings provide overall direction for forest management decisions. Specifically, the following major management directions apply from the above laws and administrative rulings:

1. State school lands were given to the State in trust from the public domain specifically for the support of common schools. As such, they are not public lands in the same sense as Federal

---

[2] Section 81-1402, Revised Codes of Montana 1947

lands are public lands. The beneficiaries of the trust are the schools and not the people of Montana.[3]

2. The word "support" has been interpreted by the courts as meaning that compensation to the State for use of trust lands must be in monetary terms.[4]

3. Trust lands may not be diverted from this income-producing function. It is the duty of the trustees to attempt to improve and maximize this income to the extent that such a plan is substantially free from the risk of loss of any trust funds expended in such an attempt or plan and that the expected return on investment is substantially certain.[5]

---

[3] Berry, Leo, "Compensation to School Trust" Memorandum to the Attorney General of Montana, November 18, 1975

[4] Griffing, V.G. 1975 "The Significance of the Trust Concept in the Administration and Management of Montana School Lands". Research paper prepared for the Seminar in Natural Resource Management at the University of Montana School of Law. 53 pp

[5] Ibid

4. The Board of State Land Commissioners in administering this trust is directed by State Law (Section 81-103, RCM 1947) to manage trust lands under a multiple-use management concept. The definition of this management concept is taken directly from the Federal Multiple-Use Sustained Yield Act with the exception that the wording "and not necessarily in the combination of uses that will give the greatest dollar return" is deleted in State Law.

5. Classified State Forest Lands designated State Forests are reserved for forest production and watershed purposes. (Section 81-1401, RCM 1947)

6. Should a parcel of State Land in one class have other multiple-use or resource values which are of such significance that they do not warrant classification for the value, the land shall, nevertheless, be managed insofar as is possible to maintain or enhance these multiple-use values. (Section 81-1302(2), RCM 1947)

7. The provisions of the Montana Environmental Policy Act (Sections 69-6501-6517, RCM 1947) which is patterned closely after the National Environmental Policy Act, requires that the adverse environmental

consequences of a planned action be minimized prior to committing the State to a course of action.

SPECIFIC MANAGEMENT DIRECTION FOR THE SWAN RIVER STATE FOREST

General guides to the administration of State Forest Lands presented in the form of a series of goals have been prepared by the Division of Forestry.[6] These goals guide Division actions on all State Forest Lands as well as the Swan River State Forest.[7]

Preparation of a formal management plan for the Swan River State Forest is now underway. The gathering of resource information for this plan is nearly complete, but management direction specific to this unit has not yet been developed. The management plan for the Swan River State Forest is scheduled for completion in November 1976.

Through a cooperative agreement with the Department of Institutions which operates a one million dollar minimum security correctional institution for young men on the

---

[6] Anonymous. 1966 "Guides to the Administration of State-Owned Forest Land" Manual, Montana Division of Forestry. 106pp

[7] Anonymous. 1974 "Goals, Objectives and Policy Manual" Montana Division of Forestry. 66pp

forest, the Division of Forestry is responsible for providing forest related work experiences to aid in the rehabilitation process. Specific management direction has been given to create productive work experiences particularly in the area of tree planting and non-commercial intermediate stand treatments such as weeding and thinning.

MANAGEMENT RESOURCES TO IMPLEMENT CULTURAL TREATMENTS

Present Management Resources

The Swan River State Forest is managed as a Unit of the Division's Northwest Area Office which is located at Kalispell. At the present time, one professional forester and three forestry technicians are permanently assigned to the forest. Forestry technicians on the forest are principally responsible for the day-to-day supervision of youth camp crews with monies for this supervision coming from the State's General Fund. Therefore, both weedings and thinnings can be accomplished with little direct crew cost to the State with the exception of supplies and materials.

When commercial forest products are removed, a State Board of Land Commissioner's ruling limits the amount of money which can be spent on slash disposal and timber stand improvement. This is set at a maximum of $3.25/MBF for slash disposal and $3.50/MBF for timber stand improvement.

Future Management Resources

The assumptions are made here that the manpower resources presently available on the Swan will represent a minimum that will be available in the future and that the maximum allowable withholding for slash disposal and timber stand improvement activities will be adjusted to reflect the same proportion of work which could be accomplished with monies presently available.

CHAPTER III

STAND DESCRIPTION

LOCATION

The stand which makes up Napa Special Management Unit consists of 142 acres on the Swan River State Forest in Lake County, specifically, Sections 33 and 34, T24N-R17W from the Montana Principle Meridian. An aerial photograph showing the stand and adjacent areas at a scale of 1:16,670 is shown in Figure 1.

The main Soup Creek Loop road passes through the stand and provides two major access routes. From the junction of Montana Secondary Highway 209 and the Goat Creek Road, the stand can be reached by travelling 3.4 miles on the Goat Creek Road and 1.9 miles on the main Soup Creek Road.

The stand can also be reached by travelling 4.9 miles on the main Soup Creek Road from its junction with Montana Secondary Highway 209. The Soup Creek campground, a developed overnight camping facility, is located .6 of a mile north of the stand on the Soup Creek Road.

THE PHYSICAL ENVIRONMENT

Topography

The stand is located at the eastern edge of the Swan Valley bottom immediately against the western edge of the

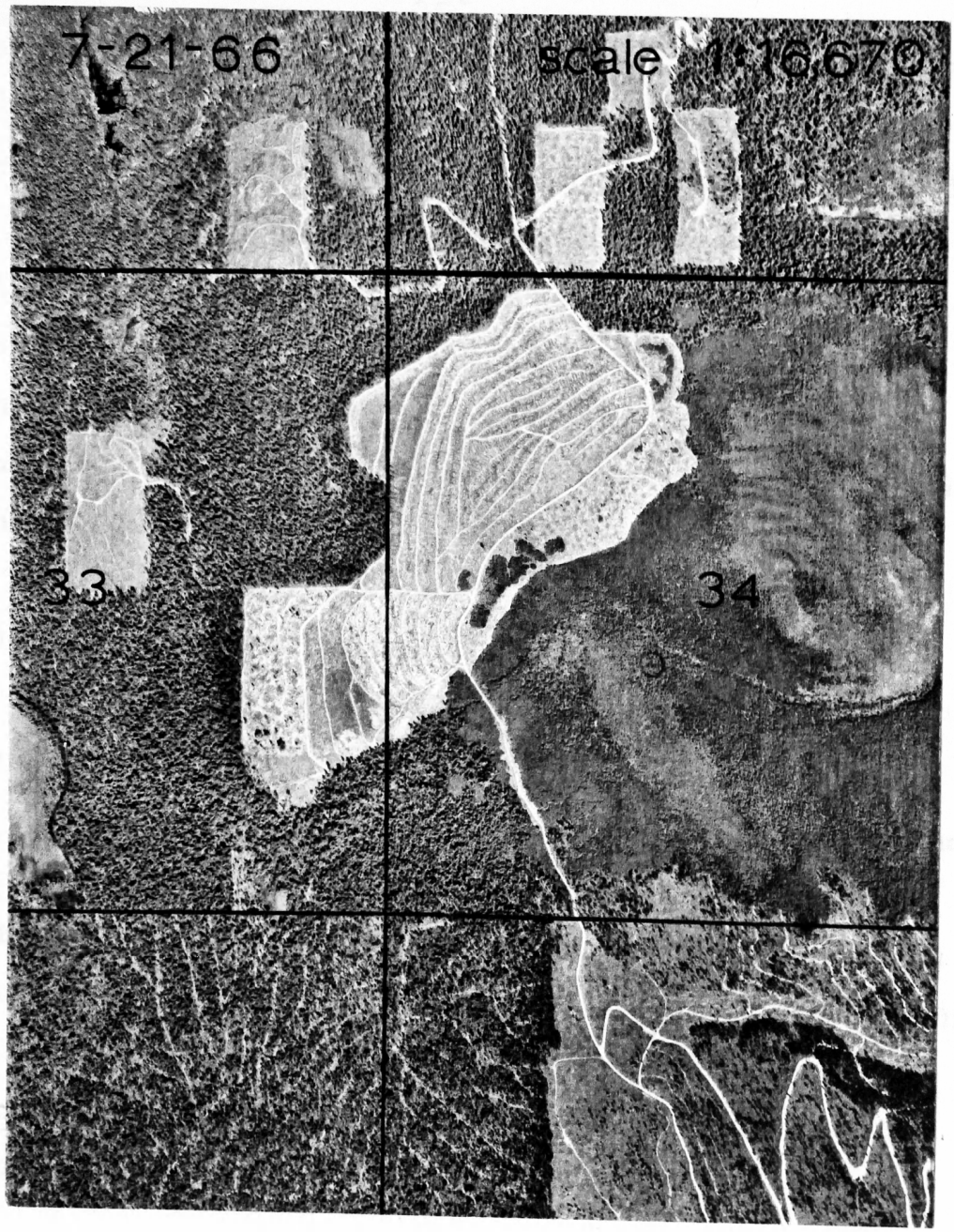

Figure 1. Aerial photograph of the Napa Special Management Unit

Swan Range. The topography within and immediately adjacent to the stand is relatively uniform and gentle with slopes ranging from 2 to 13%. Average slope throughout the stand is 8% while those immediately east of the stand average 45%. Westerly aspects from west northwest to west southwest characterize the stand with a gentle concave surface configuration characteristic of the northern half of the stand and a gentle convex configuration characterizing the south half.

Elevations within the stand run from 3640' to 3820' and rise sharply to the east to an elevation of 6802' at an unnamed ridgetop benchmark located 1.7 miles from the stand.

No streams, lakes, marshes, meadows or clearly defined intermittent stream channels are found within the stand boundary. However, Napa Creek, a year-round flowing tributary of Soup Creek is located approximately 4 chains south of the stand. Soup Creek, the major stream draining the stand, is located approximately 44 chains north of the stand.

Geology and Soils

The stand is located in the Swan bottom near the base of the west-facing scarp slope of the Swan Range. The soils within the stand are developed from parent material resulting from two different geomorphic processes. The

eastern part of the stand is located on a small, gently rolling, ground moraine from the Swan Valley glacier which also slopes very gently to the west. The soils are comparatively similar throughout the stand since the material in the fan has not been subjected to sufficiently large volumes of water to remove many fines.

According to G. Ford[1] the solum is typically from 48 to 54 inches thick and is composed of a light yellow-brown surface soil over a yellow-brown subsoil. This solum is comprised of gravelly and very gravelly medium textured soils over a calcareous substratum. Coarse fragments in these soils are derived from the Piegan One, Grinnell, and Siyeh formations. Both the alluvial fan and the ground moraine are on slopes of less than 20%.

Some profiles may have a 6 to 12 inch thick mantle of dark yellow-brown volcanic ash, but these ash thickness have not been verified by laboratory examination. Both H. Hunter and D. Alt question that this depth of volcanic ash is present within the area.[2]

---

[1] Personal Communication 1975

[2] Personal Communication 1976

This ash typically has a high cation exchange capacity, high water holding capacity. Both of these ash characteristics are silviculturally important in enabling tree seedlings to survive the critical summer drought period.

Some of the other important management interpretations for the soils within the stand are as follows:

TABLE 1

SOIL CHARACTERISTICS WITHIN THE STAND WHICH ARE IMPORTANT TO MANAGEMENT

Soil Characteristic	Management Implication
Reaction (Soil pH)	Ranges from strongly acid (4.5) at surface to moderately alkaline (8.5) in substratum.
Permeability and Infiltration	Rapid ash cap is present. Moderate in rest of profile.
Drainage	Well to moderately well
Soil Moisture Stress	Moderately high in late summer because of west aspect.
Susceptibility to Frost Heaving	Moderate to high.
Compactibility	Low potential.
Mass Failure	Low potential.
Erosion	Low on moraine and slightly higher on fan because the slopes are slightly greater.
Windthrow Hazard	Low on fan, moderate on moraine.
Shrink Swell Potential	Low

Climate

There is relatively little available climatological data for the Swan Valley. Cooperative weather observation stations are located at Bigfork, Swan Lake, Upper Holland Lake, and Lindbergh Lake providing some precipitation and temperature data. During the summer, some fire-weather data is collected by the U.S. Forest Service at Condon. Detailed meteorological data is available from Kalispell, but this station is about 40 miles from the State Forest and in a much different valley and climatological regime. Snow courses are located at Trinkus Lake, Fatty Creek and Upper Holland Lake.[3]

According to P. Bengeyfield, Swan Valley is a relatively wet area with most storms coming from the Pacific as weak maritime weather systems. Annual precipitation ranges from 25 inches on the valley floor, at elevations of 3100-3500 feet, to 70 inches at 6000-7000 feet, to over 100 inches on Swan Peak at 9255 feet.

The wettest month of the year is June, with about three inches of precipitation occurring during that time. A storm with a frequency or recurrence interval of 25 years and a duration of 6 hours would yield about 1.6 to

---

[3] Personal Communication 1976

1.9 inches of precipitation on the stand. A 25 year 24-hour storm would yield about 2.8 to 3.8 inches.

Snow accounts for 60-75% of the annual precipitation. Usually the valley bottom has snow accumulations of two to three feet with snowpacks of 10 feet and more at higher elevations. Snow is usually present in the valley from December to April and in the mountains above the stand from November to June.

Snows and killing frosts are possible every month of the year with the growing season being generally from early May to about September 1st. Mean annual temperatures in the Swan Valley are about 40° F. in the fall; 20° F. in the winter; 40° F. in the spring; and 60° F. in the summer. Clear days with unhindered solar radiation are most common from July to September.

Watershed

The stand is entirely located within the Soup Creek hydrologic unit which contains 9,088 acres. According to P. Bengeyfield,[4] average annual water yield for the Soup Creek Unit is 19,548 acre feet and this water flows directly into the Swan River 7.3 miles above Swan Lake. Cutting units within this hydrologic unit presently total 1,069 acres and are producing an increase of 256.15 acre

[4] Ibid

feet or 1.3% of the average annual water yield.

Water quality within the Soup Creek drainage is presently rated as excellent. The 1975 discharge and water quality measurements taken by P. Bengeyfield[5] at the Soup Creek hydrologic station located 44 chains north of the stand at the Soup Creek campground are presented in Table 2.

TABLE 2

DISCHARGE AND WATER QUALITY MEASUREMENTS FROM THE SOUP CREEK HYDROLOGIC STATION

Measurement Parameter	Measurement
Peak Flow	104 Cubic Feet/Second
Minimum Flow	13.9 Cubic Feet/Second
Suspended Sediment	high 3.6 mg/litter low .93 mg/litter
pH.	8.75
Alkalinity	high flow 188 ppm low flow 171 ppm
Total hardness as $CaCo_3$	high flow 205 ppm low flow 154 ppm
Temperature	41.0° F. to 48.2° F.

[5] Ibid

No water quality or discharge measurements have been taken on Napa Creek which is located south of the stand due to its small size, but water quality is believed to be similar to Soup Creek during low flows.

The ability of a stream to withstand the effects of a water yield increase is based on the stability of the channel. Soup Creek at the campground rated high in the "good" category according to U.S. Forest Service, Region 1 Channel Stability and Evaluation Procedure. Farther downstream, below the stand, the gradient is reduced due to the change in topography and more meanders are evident in the channel. During spring runoff, considerable overbank flows are common here, and no defined channel is evident.

There is no definable surface drainage within the stand and surface runoff is negligible.

Most of the precipitation and snowmelt falling on the stand percolates into the soil and moves downslope beneath the surface. The rate of subsurface water movement depends on the soil and other subsurface material encountered. Because this area is one of complex glacial deposits, the subsurface material and hence water movement varies considerably within the stand. However, no evidence of unusual water infiltration within the stand such as springs or abnormally wet areas has been observed.

The stand receives close to 30" of precipitation a year, about 60-70% of which occurs as snow. Using equations developed by the U.S. Forest Service,[6] this approximate 0.6' in runoff is contributed to Soup Creek. By multiplying this 0.6' figure by the area of the stand (142 acres) it can be shown that 85.2 Ac.ft. of runoff occurred annually from the stand in an uncut condition. The harvesting operation that took place in 1964 and created the present stand increased this annual runoff by 37.09 Ac.ft. or 43.5%. The planting of trees has resulted in the present crown canopy covering 50% of the area and has reduced this increase to 20.25 Ac.ft. or 23.8% of the uncut condition.

MANAGEMENT HISTORY

Stand Establishment and Cultural Practices

The stand which is designated Napa Special Management Unit resulted from Timber Sale 0784 called the Napa Burn Sale which was harvested in May and June of 1964. Specifically, this Timber Sale was designed to treat the general sale area in two ways depending on whether a

---

[6] U.S. Forest Service. 1975. Region 1 "Watershed Management Handbook"

manageable understory stand was present. In the 105 acres which were clearcut, the original stand was characterized by defective old growth timber heavily infested with dwarf mistletoe (Arceuthobium laricis), Douglasfir beetle (Dendroctonus pseudotsuga Hopk) and Indian Paint fungus (Echninodontium tinoctorium). These clearcut areas are designated as Areas 1a and 1b in Figure 2. The quantity and quality of timber on the area clearcut was rapidly declining and the understory which consisted almost exclusively of Grand fir (Abies grandis), was considered unmanageable.

The stand in Area 2 was similar to Area 1 with the exception that much of the original Grand fir understory was killed by a creeping ground fire during the 1924 Napa Burn and an overstocked understory of mixed species was established. The decision was made to remove only the defective overstory where a manageable understory was present and at a later date, to thin this residual understory stand to an approximate spacing of 10 x 10 by a combination of low and crown thinning methods. (Smith, 1962)

Separate records of volume harvest by species from each of these areas was not kept, but total merchantable volumes by species harvested from the stand using standard abbreviations is presented in Table 3.

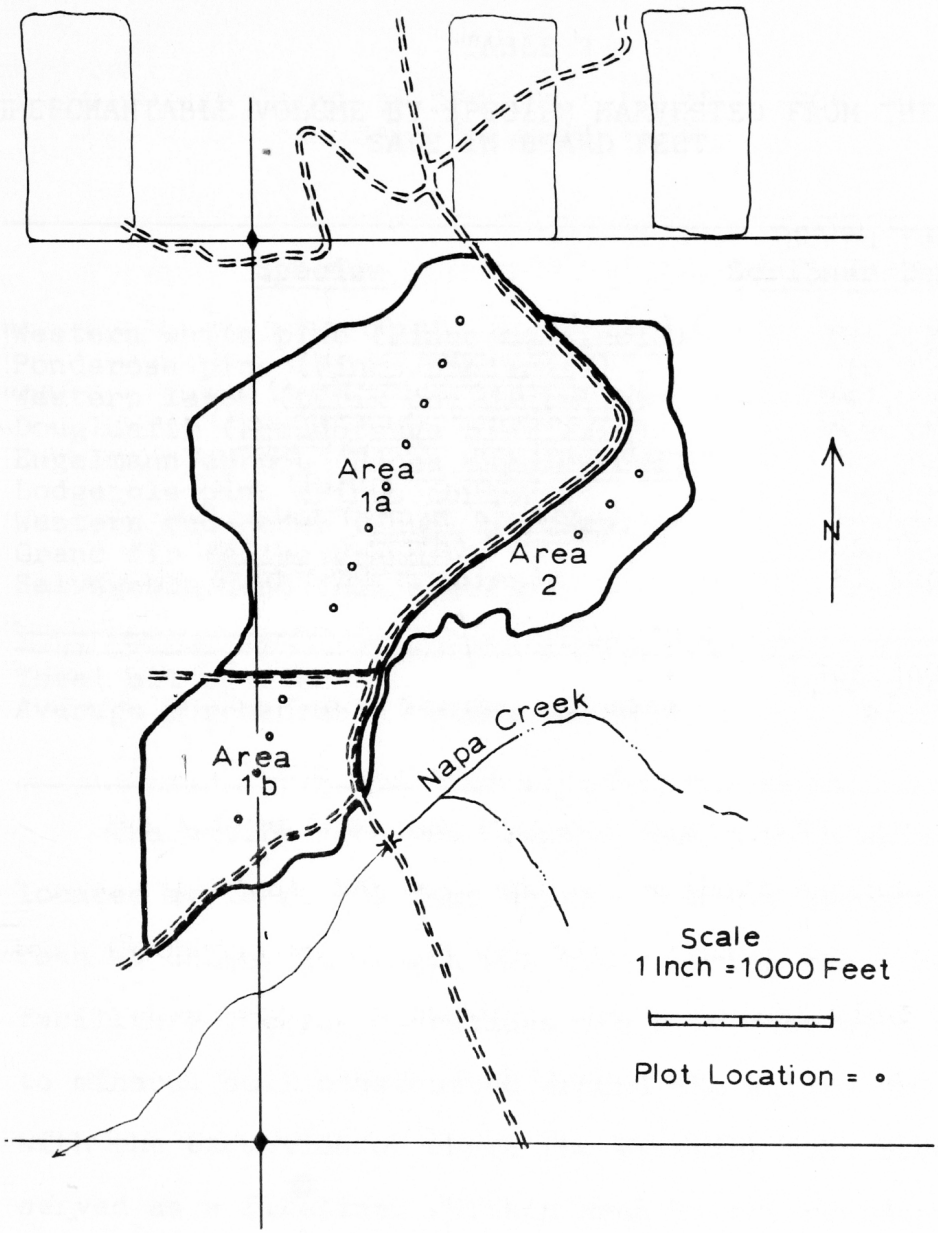

Figure 2. Map of the Napa Special Management Unit showing treatment areas within the stand and the location of stand analysis plots.

TABLE 3

MERCHANTABLE VOLUME BY SPECIES HARVESTED FROM THE NAPA BURN SALE IN BOARD FEET

Species	Board Feet Scribner Decimal C
Western white pine (Pinus monticola)	161,830
Ponderosa pine (Pinus ponderosa)	16,000
Western larch (Larix occidentalis)	467,090
Douglasfir (Pseudotsuga menziesii)	303,380
Engelmann spruce (Picea engelmannii)	43,290
Lodgepole pine (Pinus contorta)	69,890
Western red cedar (Thuja plicata)	18,040
Grand fir (Abies grandis)	255,340
Salvagable dead (All species)	51,090
Total all species	1,386,000
Average merchantable volume per acre	9,059

The entire area was tractor logged with skid trails located at least 300 feet apart. A short secondary spur road 45 chains in length was built within the stand to facilitate logging operations and a 14 foot wide fireline to mineral soil constructed around the entire sale area with the exception of where the existing road adequately served as a fireline. Within Area 1, the residual stand was cabled down after logging. In Area 2, which was tractor skidded without blades, no cabling was done and the slash lopped and scattered in areas where a manageable understory was present. After an unsuccessful attempt to

broadcast burn Area 1 and portions of Area 2, the stand was then dozer piled and burned successfully during the fall of 1964.

A variety of methods were used to successfully regenerate the stand during the period 1965-1967. These methods included natural regeneration from adjacent stands and residual trees, with the stand and artificial regeneration from planting and spot seeding. Unfortunately, the records of the planting and direct seeding operations which were conducted both by State crews and various Boy Scout Troops are incomplete. Table 4 located on the next page presents a summary of the available information on artificial regeneration methods used in the stand. All planting done in the stand used two year old seedlings. Spacing for both planting and spot seeding was approximate 10x10 foot spacing.

TABLE 4

ARTIFICIAL REFORESTATION EFFORTS IN THE STAND BY YEAR, METHOD, AREA, SPECIES, NUMBER AND ACRES

YEAR	METHOD	AREAS	TREE SPECIES	NUMBER	ACRES
1965	Planting	1a	Ponderosa pine	2,000	4.6
		1a	Western larch	4,250	9.8
	Spot Seeding	1a, 1b & 2	Ponderosa pine	Unknown	Unknown
1966	Planting	1a	Ponderosa pine	6,975	16.0
		1b	Ponderosa pine	10,275	24.0
	Spot Seeding	1a	Western Larch	Unknown	20.0
Minimum total area of stand artificially reforested					74.4

The origin of the seed used to artifically regenerate the stand is unknown for all of the above plantings and spot seedings. However, the Division's nurseryman believes that it is highly likely that the ponderosa pine planted in the stand originated from collections made on Blue Mountain, west of Missoula from an elevation of 3,200 feet.

The residual understory remaining on Area 2, which covered approximately 4 acres, was thinned in 1970 to an

approximate spacing of 10x10. As was originally planned, the thinning was a combination of low and crown thinning methods. Slash resulting from this thinning was lopped and scattered within the stand.

A total of 4.6 acres of land within the stand are presently occupied by roads. The main Soup Creek Road occupies 2.4 acres within the stand while spur roads constructed to facilitate timber harvest and maintained for continuing management use occupy 2.2 acres.

Fire

Natural wildfire has been a powerful and dominating ecological force in the Swan River State Forest and this fact can be readily observed the the mosaics of seral stands of western larch, Douglasfir and lodgepole pine. From the age and species composition of the stand immediately to the north, it is evident that the stand occupying Area 1 was essentially free of a major fire at least for the last 250 years. However, the ground fire intrusion into Area 2 which occurred during the large Napa burn fire of 1924 and burned an extensive 2,500 acre area along the eastern edge of the stand, created suitable seedbed conditions for the establishment of a new forest stand.

Fire control on the Swan River State Forest is the responsibility of the Division of Forestry. Fire crews and tankers are stationed at the Swan River State Forest

headquarters which is located only 9 minutes from the stand during fire season.

Recent improvements in wildfire control and the development of extensive road systems on the forest have markedly reduced the acreage burned by wildfires in the last 20 years. At the present time, the existing road system, which breaks up the area and provides quick access to the area, appears adequate for fire protection purposes. However, according to W. O'Brien[8] the risk from man-caused fire, has increased due to increasing use of the Soup Creek Road and campground for recreational purposes.

Range

At the present time, no grazing is permitted on the Swan River State Forest, although grazing is permitted on unfenced private ownership south of the Swan Forest boundary. Occasional unauthorized grazing use of the area has occurred in the past, but no observable damage appears to have resulted from this intrusion.

Recreation and Aesthetics

The Soup Creek Road which is the most popular recreational driving road on the forest passes through the stand for a distance of 52 chains. In addition, the Soup

---

[8] Personal Communication, 1976

Creek campground which is a nine unit campground developed for overnight camping is located .6 of a mile north of the stand and is used throughout the period May to November. Summer use of the area by the general public is moderate with the highest use occurring during the fall hunting season. During this time of year, the Soup Creek campground and adjacent areas receive intensive use as base camp locations for deer and elk hunters according to Conrad.[9] Soup Creek at, and below, the campground produces fair fishing for six to eight inch cutthroat (Salmo clarki Richardson) and eastern Brook Trout (Salvelinus Fontinalis Mitchell).

The stand cannot be viewed from Montana Secondary 209, but is visible from selected highpoints and forest roads both along the east and west sides of the valley. Though noticeable, the stand is not visually dominant or an element of discord in the characteristic landscape of the area. More noticeable and harsh in the aesthetic impact is the regularly patterned 20 acre rectangular clearcut blocks found in the immediate vicinity of the stand. So clearly visible due to their line, form, color

---

[9] Conrad, R.M. 1964. Recreational Use and the "renewable" resources, Swan River State Forest, Montana. M.A. Thesis. Montana State University, Missoula, Montana. 139 pp.

and contrast, these 20 acre units are readily identified on ERTS satellite photographs of the area.

PRESENT STAND CONDITIONS

Statistical Data on the Present Stand

On October 9, 1975 in connection with an assignment for the Continuing Education in Forestry and Silviculture Session III, held in Moscow, Idaho, I sampled the stand by establishing 15, three-hundredth acre circular plots and conducting a walk through examination of the stand. The stand examination procedure used was a modification of the U.S. Forest Service Stage II examination procedure. The statistical summary of this examination is presented in Table 5. The approximate plot location is shown in Figure 2. Estimated average site index for all species within the stand is site index 70 on a 50 year base.

TABLE 5

STATISTICAL SUMMARY OF STAND EXAMINATION

Measurement	Trees Present in Stand Using Standard Abrevs. WWP	PP	WL	DF	LLP	ES	GF	SAF	Stand Averages or Per Acre Totals
Number of trees/acre	20	220	260	20	20	--	--	80	620
Potential crop trees/acre	0	140	240	0	20	--	--	0	400
Average height in feet	1.0	4.5	9.6	2.0	11.0	--	--	1.5	6.3
Average height of crop trees[1] in feet	0	5.6	10.2	0	11.0	--	--	0	8.6
Average age in years	10	11	10	10	10	10	10	10	--
Average dbh in inches	0	.3	1.0	0	1.6	--	--	0	.6
Average crop tree dbh[2] in inches	0	.5	1.1	0	1.6	--	--	0	.9
Average spacing in feet	46.7	14.1	12.9	46.7	46.7	--	--	23.3	8.4
Average spacing of crop trees in feet	0	17.6	13.5	0	46.7	--	--	0	10.7

[1]Crop trees are defined as those trees of good form and vigor that would allow them to be desirable stand components over the rotation.

[2]Dbh is defined as the diameter of the tree at a point 4.5 feet above average ground level.

Stand Dynamics

Three special conditions exist within the stand as defined are of sufficient importance to be recognized as separate areas within the stand.

Area 1a consisting of 73.3 acres is presently adequately stocked with the exception of a small five acre area which presently has only 150 trees/acre. Estimated distribution of species within the area is 70% western larch, 25% ponderosa pine, and 5% for all other species. General vigor of the western larch is excellent with dominants and co-dominants exhibiting 22"-28" average annual leader growth as compared to 16"-22" for ponderosa pine. Leader growth is variable within this area with the poorest leader growth generally found along the western edge of the stand where dozer scarification was markedly less efficient in reducing understory shrubs, forb and grasses. No observable mortality of ponderosa pine or other species due to competition was apparent. However, some mortality is expected to occur to the ponderosa pine 2-4 feet tall during the next five to seven years under present stand conditions, due to overtopping by western larch. Health and vigor of the crowns and vigor of all potential crop trees observed appeared excellent.

Area 1b which consists of 32.2 acres is presently adequately stocked. The estimated distribution of species

within the area is 80% for ponderosa pine, 15% for western larch adn 5% for all other species. The relatively low stocking of western larch in this area is attributed to both lack of planting or spot seeding and to the lack of adequate seed source immediately west and south. General vigor of the ponderosa pine is better than in Area 1a with dominants and co-dominants exhibiting 18" to 24" average annual leader growth. Average annual leader growth in western larch is somewhat poorer than in Area 1a with 16" to 22" the average for this area. The majority of the western larch on the area is concentrated along the west and south boundaries with those growing outside of the border zone clearly beginning to show the effects of competition with the firmly established ponderosa pine. With the exception of these western larch the general health and vigor of the crowns and foliage of potential crop trees appears to be excellent.

Area 2 which consists of 31.9 acres is presently adequately stocked. Estimated distribution of species in the stand is 55% for western larch, 20% for ponderosa pine, 10% for lodgepole pine, 5% for Douglasfir and 10% for all other species. General vigor of the larch is excellent with dominants and co-dominants exhibiting 20"-26" average annual leader gorwth as compared to 16"-22" for both ponderosa and lodgepole pine. As was noted in Area 1a, ponderosa pine has clearly begun to fall behind western

larch in both height growth and general vigor. The approximate four acres of residual understory within this area has responded in a variable fashion to the overstory removal and to the subsequent 1970 thinning. Increment cores taken from western larch, Douglasfir and lodgepole pine showed fair to moderate release, but clearly many of these trees should be removed at the first commercial opportunity as a combined thinning and improvement cut.

Habitat Types

The entire stand falls within the Abies grandis/Clintonia uniflora habitat type (ht) as defined by Pfister (1974). The author's observations and habitat typing adjacent stands indicates that both the Clintonia uniflora and the Aralia nudicaulis phases of this habitat type are present in the stand with the latter phase confined primarily to the extreme edge of the stand near Napa Creek. Due to the degree of site disturbance caused by timber sale activities precise delineation of phase boundaries was not possible.

In the Swan, western larch appears to have the competitive edge over Douglasfir restocking new areas while the initial re-establishment of Grand fir is slow in larger openings on valley bottom sites.

Wetter areas south and west of the stand are extensively covered by the Thuja plicata/Clintonia uniflora h.t.

The Picea engelmannii/Clintonia uniflora h.t. is found along narrow streamside strips and wet meadows along Napa and Soup Creek both west and north of the stand.

The Clintonia uniflora and the Aralia nudicaulis phases of the Abies grandis/Clintonia uniflora h.t. on the Swan River State Forest are of extremely high productivity. The 50 year site index given by Pfister (1974) of "69±11 for DF, 68± ? for ES and 64±15 for GF" are considered by the author as conservative for this h.t. on the Swan. However, very little data exists from actual site tree measurements taken on the Swan to accurately approximate the actual site indexes within this h.t. for all species present. Until additional site data is available an average site index of 70 is assumed for all species in this habitat type.

Characteristic understory species found within the stand are Clintonia uniflora, Coptis occidentalis, Amalanchier alnifolia, Aralia nudicaulis, Pachistina myrsinites, Ceanothus sanguineus, Holodiscus discolor, Vaccinium membranaceum, Carex geyeri, Xerophyllum tenax, and Bromus vulgaris.

Insects and Disease

No serious insect problems are present within the stand or were observed in stands immediately adjacent. For at least the last five years, a large area of larch casebearer

(Coleophora laricella Hbn.) defoliation has been present in young saplings and pole size larch stands along the north end of the Swan River State Forest. Its advance has apparently been limited by unfavorable elevation and climatic conditions according to S. Kohler.[10] Other insects which have been present or adjacent to the forest in near epidemic proportions in the recent last 20 years have been the Douglasfir bark beetle (Dendroctonus pseudotsuga Hopk), and the Engelmann spruce beetle (Dendroctonus engelmannii Hopk.). The western pine beetle (Dendroctonus brevicomis Lec.), are present on the forest only in low endemic levels. No damage from western budworm (Choristoneura occidentalis) has been observed in Douglasfir, grand fir or western larch. No serious Ips problem has occurred on the forest.

The most serious disease problem threatening the stand at the present time is the larch dwarf mistletoe (Arceuthobium laricis). It is present in the stands immediately to the north and west and was present in the overstory in Area 2 prior to its removal. As a result, the north, west and eastern edges of the stand have in the past or are presently exposed to moderately heavy dwarf mistletoe

---

[10] Personal Communication

seed source. However, during the initial stand examination, only two young trees in the thinned portion of Area 2 showed mistletoe infection. Neither the Douglasfir dwarf mistletoe (A. douglasii Engelm) or the lodgepole pine dwarf mistletoe (A. americanum Nutt) are presently found in adjacent stands.

Several rots were abundant in the pre-existing stand. However, no indications of Fomes pini, Echninodontium tinctorium and Fomes annosus were found during the initial stand examination. Likewise, no indication of an Armillaria mellea problem was found, although a serious problem with this root rot is present in a portion of nearby Section 4, T23N-R17W.[1]

Wildlife and Fisheries

Specifically, this stand is an important source of big game browse with heaviest winter use by elk (Cervus canadensis) and summer and fall use by mule deer (Odocoileus hemionus). Preferred shrub species for big browse in the stand are redstem ceanothus (Ceanothus sanguineaus), service berry (Amelanchier alnifolia) and Mountain willow (Salix scouleuana). Black bear (Ursus americanus Pallus) have been observed feeding on huckleberries within the stand.

No raptors have been observed to have nests within or adjacent to the stand, but hawks have been observed hunting Columbia ground squirrels (Citellus columbianus)within the

area. Ruffed grouse (Bonasa umbellus L.) are regularly encountered along the northern edge of the stand boundary.

Non-game mammals known to live in or to occasionally use this stand are the Columbia ground squirrel, coyote (Canis Latrans), porcupine (Erethizone dorsatum), least chipmunk (Eutamias minimus), and the northern pocket gopher (Thomomys talpoides). None of these animals appear to have caused noticeable mortality or damage within the stand.

There are no fishery streams within or in close proximity to be significantly influenced by silvicultural or other management practices performed within the stand.

Genetic Potential

Some of the finest western larch to be found in western Montana in terms of height and form were located directly north of the stand just above the Soup Creek campground. During the past ten years, most of these trees have been selectively removed for transmission poles and house logs. However, these and other western larch both within and adjacent to the stand provided the majority of the seed which naturally restocked this stand. Not much is known about the magnitude of local genetic variation in this specific area, but the following assumptions are believed to apply.

1. "Species occupying the greatest range of environmental variation will display the

greatest amounts of genetic variation. In the diverse environments of the Rocky Mountain region, ecological amplitude is probably the best measure of environmental variation."

2. "Geographic factors being comparable, a species having a population structure of small, isolated groups is likely more total genetic variation than a species structure from large continuous populations." Western larch appears to have developed since valley glaciation in this area approximately 10,000 years ago as large continuous populations subjected to periodic wildfire.

3. "In the absence of data to the contrary, the greatest source of genetic variation are geographic (Provenance) and elevation followed in order by stand to stand and tree to tree."

Through man's management activities, new genetic materials from outside the area have been introduced into the stand. Both the seed sources of the western larch and ponderosa pine planted or spot seeded within this stand are unknown. Identification of this newly introduced genetic material will be more difficult with the passage of time. Examination of young western larch failed to discern planted

or spot seeded seedlings from natural seedlings, and new alleles have been introduced into both the western larch and ponderosa pine populations in this area. The stand along the northern boundary of the stand contains old growth ponderosa pine populations in this area. The stand along the northern boundary of the stand contains old growth ponderosa pine which has contributed new natural seedlings to the stand, particularly in the northeast corner of Area 2.

CHAPTER IV

MANAGEMENT CONSIDERATIONS

SPECIAL CONSTRAINTS APPLYING TO NAPA SPECIAL MANAGEMENT UNIT

In addition to those management constraints previously presented in Chapter II, all management practices must be designed to meet all existing Division of Forestry management direction, and all State and Federal laws applicable to State-owned forest land, and practices performed thereon. Furthermore, in the design and execution of all management actions, the Division attempts to make these actions compatible and in keeping with the responsibilities of other state agencies, federal land management agencies with responsibilities in the immediate area, and adjacent and intermingled forest landowners.

The absence of an approved management plan makes the job of defining specific management constraints for this stand somewhat of an interpretive exercise on the part of the author. However, from the information previously presented, the following can be inferred as management direction and constraints whichare likely to be embodied in a management plan for the area.

1. A well-travelled forest road is located within the stand and all management practices are readily visible to the public. Aesthetic considerations

must be a part of all planned actions.

2. The high productivity of the area for timber values will be the focus of management actions initiated within the stand.

3. Existing signing of the area informing the public that this is a special management area will continue its use as a demonstration area for forest management practices.

4. Protection of the young stand from fire, insects and diseases (particularly dwarf mistletoe) will have a high priority in management decisions.

5. All management actions planned for the area will be reviewed in accordance with the Division's environmental procedures which require the preparation of an Internal Environmental Impact Statement prior to the approval of the action.

6. The commitment of the Division to provide productive forest-related work experiences for inmates at the Youth Forest Camp both facilitates and mandates the use of these crews to perform non-commercial cultural treatments within young forest stands. The stand is particularly well suited for this purpose because of its location and ease

provides winter work experiences which have been generally difficult to provide in the past.

MANAGEMENT ALTERNATIVES

Before addressing the question of management alternatives, the question of whether we are in fact, dealing with one or more stands within this special management unit must be addressed. In the biological sense, it is readily clear that we are dealing with three separate stand situations at this point in time, which will require separate management prescriptions. However, from the management point of view, the similarities within the area and established management direction dictate that the stand be handled under one coordinated management prescription. It is this latter approach which I believe will facilitate the development of the most appropriate management prescription for the stand and allow it to be carried out over time. In each of the possible alternatives presented below, these different areas within the stand will be addressed separately and ultimately permit the stand to become more uniform with time and fit the stand definition of Smith (Smith, 1962).

Manage Without Cultural Treatments

Without cultural treatments to achieve the desired stocking levels and species composition over time, the

productive potential which presently exist within the stand will not be realized. All areas within the stand with the possible exception of a small understocked five acre area in Area 1a, which presently has less than 150 established seedlings per acre, will be overstocked within the next 30 years. Both reduced growth and irregular natural thinning of the stand is expected to occur. This will result in the proportion of ponderosa pine carried to rotation age will probably decrease with the possible exception of those portions of Area 1b which have very few established western larch seedlings.

Over time, competition between individual trees will generally increase the stand's susceptibility to both insects and disease. Dwarf mistletoe will have infected a significant portion of the stand in a two to three chain wide strip along the western and northern boundaries of the stand and in Area 2. (Hawksworth and Wiens, 1972) Yields of useful forest products will be significantly reduced and the "natural" appearance of the stand will be enhanced. Organic debris will be increased and remain untreated resulting in an increased fire hazard on the area. Finally, natural successional and biological processes will not be disrupted by man's cultural activities within the stand.

Manage to Favor Specific Forest Resources

Wood Products

To achieve this objective the stand would be intensively managed through a series of intermediate stand treatments designed to concentrate the gorwth potential of the site on selected crop trees. A carefully programmed series of pre-commercial and commercial thinning would be designed to keep all residual trees growing at their optimal rates in terms of both wood volume increment and wood quality. To achieve this alternative, an increased investment of time and money would have to be made in the stand including possible fertilization, pruning, and improved forest protection from both fire and insects and diseases. However, considering financial limitations applying to the management of State Forest Lands, all investments will have to be strictly evaluated in an economic sense and yield financial returns greater than their cost plus reasonable interest over the investment period.

Recreation and Aesthetics

The maximization of recreation and aesthetic values from this stand and the degree to which these values are possible is controlled principally by the language and legal interpretations of the Enabling Act. The resultant

requirement cited by Griffing[1] that "the trust property (lands) may not be diverted from this income-producing function" is controlling over state laws concerning natural areas, multiple-use, etc., and the administrative discretion of the trustees." To maximize recreation and aesthetics values alone, would require that the income (both short and long-term) exceed all other values. For the stand in question, this is clearly not a possibility at the present time or for the foreseeable future as the existing campgrounds are either under lease to the Fish and Game Department for small annual payments or for concentrating public use to assist in fire protection on State lands (e.g., Soup Creek campground).

Low intensity forest based recreational activities appear to pose little danger to the income producing potential present within the stand. However, some decline in timber productivity of the site could be anticipated if developed recreation facilities or heavy recreation use are created.

Wildlife

Wildlife management is the designate responsibility of the Montana Fish and Game Department and all on-the-ground

---

[1] Griffing, "The Significance of the Trust Concept in the Administration and Management of Montana School Lands. pp. 46-47

management actions are coordinated in an attempt to maximize beneficial wildlife impacts and minimize adverse impacts within economically feasible limits. Again, maximization of wildlife values in the stand must be considered from the point of view of its impact on income to the trust. At the present time, no income accrues to the trust from wildlife using this stand.

The alternative to maximize wildlife values in this stand would focus on maintaining a wide variety of habitat conditions and encouraging additional diversity within the stand. (Siderits, 1975) To achieve this, it would probably require a combination of treatments designed to maintain reduced stocking to increase the vigor of shrubs, forbes, and grasses. In this stand, such treatments would probably include periodic revitalization of understory stands of shrubs, forbes, and grasses by prescribed burning to maintain established elk and deer browse within the stand. The approach to maximizing small and non-game species would probably require adopting a "featured species" concept as presented by Holbrook (1973).

Grazing

Opportunities for the maximization of grazing values within this stand are limited at the present time. Maximization of the grazing potential of this site would require removal of the existing stand and a substantial

investment in site preparation, seeding, water development, fencing, etc. Given the nature of the area, the development costs involved, and expected financial return, the success of such a development is highly questionable.[2]

Watershed

At the present time, no specific direction exists to maximize the quantity of water derived from State lands. However, two specific Division goals exist in regards to prevention of damage to the watershed and the maintenance and improvement of water quality.[3] These goals are "to manage each watershed in such a manner that runoff, soil and stream channel erosion, and sedimentation are controlled, and "to utilize land management actions which will maintain or improve the quality of water flowing from each watershed."

All management actions are designed to achieve these above goals. The goal to achieve the maximum production of water from this stand would require control of all vegetation to reduce transpiration and interception losses. (Hibbert, 1966 and Rice, Rothacher, and Megahan, 1972) The practices to achieve this degree of vegetation control and their resultant increase in water yield would be in

---

[2] Personal communication with V. Frezzo, Range Forester, Montana Division of Forestry,1976.

[3] Anonymous. Goals, Objectives and Policy Manual. p. 25

direct conflict with the achievement of these established goals. Under the goal of maximization of water yield, the stand would be effectively removed from timber production whereas existing Division goals are fully compatible with continuing timber production if sound management practices are utilized.

Manage To Increase Stand Diversity

This alternative is not specifically provided for either in State law or established management direction. However, it is a logical extension of established policy direction to manage classified state forest lands in a biologically sound manner and to reduce the risks of loss. Some undetermined loss of timber production would result depending upon the level of diversity in terms of age classes, species composition and stand density set as a target. Choice of this alternative would require that the desired level of diversity be set and then a specific evaluation be carried out to determine the economic, social and environmental consequences that would result.

Manage For Genetic Improvement

Within the existing stand this alternative would involve phenotypic selection favoring retention of those trees which exhibit desired genetic traits. Rigorous pursuit of this alternative could lead to either an understocked or overstocked stand during this rotation depending

upon the criteria set for genetic selection. Specific Division direction in regards to this possible management alternative is stated as follows:[4] "To improve the desirable characteristics of commercial species of timber whenever possible through succeeding generations by sound genetic harvesting, seed selection and tree improvement practices."

Particularly good opportunities exist for genetic improvement within this stand because of the young age of the stand, the relative uniformity of the site, and the management possibility to keep the stand growing under near optimal conditions by continual cultural treatment. Libby, (1968, 1973 and 1974) provides a more complete discussion of possibilities for genetic improvement in the situation described above.

---

[4] Ibid. p. 8.

CHAPTER V

STAND PRESCRIPTION

CULTURAL TREATMENTS DURING THE ROTATION

This prescription is designed to maximize the productive potential of this site for wood products while providing for genetic improvement, recreation, wildlife and watershed values.

The prescription objective is to achieve an acceptable stand species composition, condition and age arrangement at rotation age of 110 years. To accomplish this, the prescription is designed to keep the stand as a whole in a healthy and productive state by adjusting stand density in such a manner as to keep the stand growing at or near its potential growth while favoring the most desirabel individual trees present.

The 110 year rotation age should be considered tentative at this time until the performance of this stand under management can be further evaluated at a later date. This recommendation is in accordance with the following statement by Schmidt, Shearer, and Roe (1976). "The effects of close stand regulation over long periods of time are not presently known, and these effects can be learned only by studying managed stands over time.

The prescription presented below is the result of

TABLE 6

SUMMARY OF PRESCRIBED MANAGEMENT ACTIONS OVER THE LIFE OF THE STAND

Year	Stand Age	Management Action
1976	10	Dwarf mistletoe sanitation along stand boundary
1977	11	Noncommercially thin 29 acres Area 1 and 28 acres Area 2 to 680 trees/acre
1982	16	Noncommercially thin remainder of Areas 1 and 2 to 360 trees/acre
1987	21	Noncommercially thin 1977 thinning areas to 360 trees/acre
1997	31	Commercially thin stand to 270 trees/acre
2015	49	Commercially thin stand to 200 trees/acre
2031	65	Commercially thin stand to 140 trees/acre
2046	80	Commercially thin stand to 105 trees/acre
2062	96	Commercially thin stand to 85 trees/acre
2076	110	Final harvest of stand with exception of seed trees
2078 - 2082	112 - 116	Removal of seed trees when 800 seedling/acre become established

computer simulation using Al Stage's Growth Prognosis Model (1973). The U.S. Forest Service (1973) Growth Management Guides for Western Larch, and the author's own observations. Table 6 presents a summary of prescribed management actions over the life of the stand. A detailed description of these management actions by location and year is presented below.

MANAGEMENT ACTIONS IN ADJACENT STANDS

Year 1976

Complete removal of all dwarf mistletoe infected seed trees in cutting units located along western stand boundary. These units have been adequately restocked with western larch and the remaining seed trees constitute a serious risk to not only the larch reproduction in these units, but to the western edge of this stand.

Complete removal of all western larch in the stand immediately north of the stand for a minimum distance of three chains into the stand. (Alexander and Hawksworth, 1975) The objective of this action is to completely remove the very heavily dwarf mistletoe infected stand of western larch to prevent continued reinfection of the northern edge of the stand. Careful field examination of the young larch in the north end of the stand during December 1975 showed no visible mistletoe infections at that time.

It is recommended that both of the above actions be incorporated into one timber sale. No management action to protect the stand from dwarf mistletoe is required at this time along either the south or east boundaries.

INTERMEDIATE STAND TREATMENTS

Year 1977, Stand Age 11

Non-commercially thin a border strip three chains wide along the north and western edges of stand. Total area to be thinned is 29 acres. The objectives of thinning are to reduce overstocking along these edges and to remove any dwarf mistletoe infections which are apparent at that time in western larch. The combination low and crown thinning is to be carried out only in western larch, favoring largest best formed disease-free trees and leaving a residual stand of approximately 680 trees/acre (approximately 8' by 8' spacing). Thinning should be carried out in the fall or early winter after the larch have lost their needles to better observe dwarf mistletoe infections.

Non-commercially thin western larch in Area 2 (with the exception of the 4 acres of residual understory) by a combination low and crown thinning to approximately 680 trees/acre. Total area to be thinned in Area 2 is approximately 28 acres. The objectives of this thinning are to remove all young western larch with visible dwarf

mistletoe infections and to make a preliminary adjustment of stand density prior to the next stand entry.

Year 1982, Stand Age 16

Non-commercially thin the entire stand (with the exception of the four acres of residual understory left in Area 2) to approximately 360/acre (approximately 11' by 11' spacing) by a free thinning favoring the largest and best trees of each species within the available growing space. The objective of the thinning is to leave a mixed species stand consisting principally of western larch and ponderosa pine. More specifically, the free thinning will consist of a simultaneous selection thinning to eliminate scattered undesirable dominants, a crown thinning to release good dominants and thrifty co-dominants capable of becoming crop trees, and a low thinning to reduce overall competition within the stand.

In the areas thinned during the 1977 stand entry all western larch showing dwarf mistletoe will be removed prior to the choice of the most suitable leave tree. The best results will be obtained from this thinning if it is scheduled during the fall or winter to make the infections more noticeable.

Year 1987, Stand Age 21

Non-commercial thinning of the 29 acre area along the west and north boundaries of the stand and of the 28 acres

of Area 2 thinned in the 1977 stand entry. Removal of all trees showing dwarf mistletoe infection to be carried out in fall or early winter after the larch have lost their needles. The proposed thinning area should be carefully examined prior to the scheduling of this thinning. This scheduled thinning may not be necessary depending on the result of the 1982 stand entry.

Year 1997, Stand Age 31

Commercially thin the entire stand to approximately 270 trees/acre (approximately 13' by 13' spacing). Thinning will consist of a free thinning (combination of low and crown thinning methods) to leave best crop trees in terms of crown, stem, form, and vigor irregardless of species. Approximately 90 trees/acre (less unsalvaged mortality) with an average d.b.h. of 6.3" and containing an estimated volume of 144 cubic feet/acre will be removed from the new stands.

Commercially thin the residual overstory and understory trees left in Area 2 during this stand entry removing any dominants, co-dominants, or intermediates that have not responded to previous release or will be lost to mortality before the next scheduled stand entry. Growing space adjustments in the four acres of residual in Area 2 are expected to leave approximately 140 trees/acre (approximately 18' by 18' spacing) and yield an estimated 1440 cubic feet/acre of

useable wood.

Consider possible pruning of selected ponderosa pine and western larch within the stand. The decision to prune and specific pruning guides for this stand are to be developed based on economic evaluation of expected return.

Year 2015, Stand Age 49

Commercially thin the entire stand to approximately 200 trees/acre (approximately 15' by 15' spacing). Thinning will consist of a crown thinning to leave the best trees in terms of crown, stem, form, vigor, irregardless of species. Approximately 70 trees/acre (less unsalvaged mortality) with an average d.b.h. of 10.2" will be removed. An estimated average of 966 cubic feet per acre will be harvested from this thinning.

Year 2031, Stand Age 65

Commercially thin the entire stand to approximately 140 trees/acre. Thinning will again consist of a free thinning (combination of low and crown thinning methods) to leave the best trees in the terms of crown, stem, form, and vigor although some adjustment may again be necessary to favor ponderosa pine to assure the desired proportion of ponderosa pine at the rotation age. Approximately 60 trees/acre with an average d.b.h. of 12.0" will be removed less unsalvaged mortality that has occurred during the

period. An estimated volume of 1302 cubic feet per acre will be harvested during this stand entry.

Year 2046, Stand Age 80

Commercially thin the entire stand to 105 trees/acre (approximately 20' by 20' spacing). Thinning will be a crown thinning to leave the best crop trees in terms of crown, stem, form, and vigor. Again, special consideration will be given to retaining the desired proportion of ponderosa pine at rotation age. Approximately 35 trees/acre with an average d.b.h. of 14.1" will be removed less unsalvaged mortality that has occurred during the period. An estimated volume of 1,208 cubic feet/acre will be harvested during this stand entry.

Year 2062, Stand Age 96

A detailed stand examination and recommendations for the final planned commercial thinning and the harvest cut will be made at this time so that the last commercial thinning will serve as a preparatory cut for the final cut if the stand is to be regenerated from the existing stand.

Commercially thin the entire stand to 85 trees/acre (approximately 23' by 23' spacing). Thinning will consist of a crown thinning to leave the best trees in terms of crown, stem, form, vigor, and seed production potential. Again, special consideration will be given to retaining the desired proportion of ponderosa pine at rotation age.

Approximately 20 trees/acre with an average d.b.h. of 16.0" will be removed less unsalvaged mortality that has occurred during the period. An estimated volume of 980 cubic feet per acre will be harvested during this stand entry.

Year 2076, Stand Age 110

Average stand diameter is 17.8". Average stand volume per acre is estimated 5,650 cubic feet prior to final harvest.

FINAL HARVEST AND REGENERATION CUTTINGS

The preceding planned program of silvicultural treatments has been designed to utilize an even-age management system in reproducing the future stand.

Specifically, the silvicultural treatments have been designed to naturally regenerate the stand by either the clearcutting, seed tree, or shelterwood reproduction method depending upon the managemnet considerations and direction which exist at that future time. (Foiles and Curtis, 1963 and Hermann 1970). These considerations will dictate the specific system used.

Artificial regeneration of the stand utilizing genetically improved stock is expected to utilize the clearcut or seed tree reproduction method depending upon the species which are to be featured in the future stand.

Given the presently existing information and management direction, the author recommends the natural re-establishment of a mixed stand of western larch and ponderosa pine on this site in the approximate proportions of 85:15 at rotation age. The preceding silvicultural treatments combined with the following regeneration cut utilizing the seed tree reproduction method is recommended.

Year 2076, Stand Age 110

The exact date of the final harvest cut will be determined by examination of the potential seed crop during 2075 and 2076. Removal of an average 75 trees/acre leaving 10 seed trees per acre (7 western larch and 3 ponderosa pine) evenly distributed over the area in a final harvest cut. (Shearer, 1971)

The principle considerations in the choice of seed trees will be the ability to produce seeds and wind firmness. Average seed tree spacing will be 66 feet. An estimated volume of 4,985 cubic feet/acre will be removed during this stand entry. Logging slash will be removed from around the bases of seed trees and the seedbed prepared for natural regeneration by broadcast burning during the fall of the year. Light followup dozer scarification with a brush blade may be needed the following spring depending upon the success of the broadcast burn.

Years 2078 to 2082, Stand Age 112 to 116

Removal of seed trees when an average of 800 two-year old seedlings per acre have become established uniformly over the area. The date of final seed tree removal to be determined by an annual reproduction survey initiated after the 2076 harvest.

MANAGEMENT AND SILVICULTURAL CONSIDERATIONS OVER THE MANAGED LIFE OF THE STAND

Stand Examinations and Records

General stand examinations will be scheduled at approximately five-year intervals throughout the life of the stand. The purpose of these examinations will be to assess the general health, vigor and general stand dynamics to serve as a basis for making necessary adjustments in the stand prescription. The results of all stand examinations will be in writing with the original examination report placed in the section stand folder. A principle objective of the next and possibly the following stand examination will be to more precisely identify the site index for this stand as a whole and to make appropriate adjustments in the stand projection and the prescription itself.

STAND PROTECTION

Cultural Treatments and Timber Harvest

The first and possibly second thinning of the entire stand will be carried out by crews from the Youth Forest Camp as well as the various thinnings aimed at removing dwarf mistletoe from the stand. The commercial thinnings and final harvest will be carried out by a series of timber sales or timber permits sold to the highest qualified bidder with all trees to be removed carefully marked prior to sale. All such sales will be subject to full compliance with all existing standard restrictions for stand protection during thinning and logging operations.

During the first three commercial thinnings, horse logging is the recommended skidding method with skidding tractors without blades (D-4 or smaller) as a secondary recommendation. The first commercial thinning is designed for on-site processing along existing roads using a small size machine similar to the "Garrett Ecologizer". (Adams and Allen, 1974) Logs skidded to the Soup Creek Road will have to be decked along the road while waiting manufacture or hauling. To avoid logging conflicts with other forest users, all thinnings and harvesting activities should be scheduled during the period December through May. To reduce

soil compaction within the stand, skidding operations should be carried out while the ground is frozen. No additional roads or permanent skid trails should be necessary to effectively manage the stand during this rotation.

Slash Disposal and Fire Protection

Both slash disposal and fire protection are presently the responsibility of the Division of Forestry within this stand and this responsibility is expected to continue throughout the life of the stand. Slash disposal will consist of lopping and scattering during all thinning operations. In addition, logging slash created by commercial thinnings will be handpiled and burned in small piles within a strip one chain wide along either side of the Soup Creek loop road in such a manner that residual trees are not damaged.

Existing internal and boundary spur roads and firebreaks will be cleared of all branches, tops and cull material to provide a minimum 33' wide fuel break as may be appropriate after each stand entry. Slash along these breaks will be handpiled in such a manner that they can be burned without damage to residual trees. Lopping, scattering and handpiling of slash will be done during the spring of the year and completed prior to June 15. Burning of roadside and firebreak piles will be done during the fall of the year after the first snowfall.

After final harvest broadcast burning is the recommended method to slash disposal to retain as much as possible the 6 to 12 inch mantle of dark yellow-brown volcanic ash. Previous slash disposal and site preparation practices have irregularly redistributed this layer over most of the stand and this is probably the major reason for the observable differences in tree height and vigor between dozer scrap and dozer piled areas that can be observed at the present time.

Recreation and Related Activities

Recreation and related activities are projected to increase both in the stand and within the general area. Increased spring and summer recreation use is expected to increase the risk of man-caused fire within this part of the forest. One of the principle reasons for the development of the Soup Creek campground located north of the stand was to concentrate camping activities to lessen the possibility of escaped camper fires.[2] Roadside camping and picnicking should be discouraged during the fire season, along the upper Soup Creek road where it passes through the stand and along all spur roads in the immediate

---

[1] Conrad. Recreational Use and Renewable Resources, Swan River State Forest, Montana p80

[2] Ibid. p81

vicinity of this stand.

Vandalism has occurred in this stand in the past with destruction and damage of signs and the occasional indiscriminate cutting of trees. A large yellow pine (30" d.b.h. and 120' tall) used as a fire lookout tree by the Civilian Conservation Corps during the 1930s was located within the stand along the Soup Creek Road and a sign erected to inform the public of its past use. This tree was maliciously cut down during 1973 by unknown persons. Random vandalism is expected to continue throughout the life of the stand and public cooperation and understanding should be solicited to keep such activities to a minimum.

Wildlife

Only minor animal damage has been observed in this stand in the past. Deer and elk have damaged and deformed several trees to sharpen their antlers (principally in Area 2) and very heavy use of red stem ceanothus and mountain willow has resulted in the killing of scattered plants within the stand. However, no major damage from big game animals is expected in the immediate future.

No porcupine damage to ponderosa pine or lodgepole pine has been observed within the stand or in the immediate vicinity of the stand within the last ten years. However, porcupine activity within or near this stand should be

followed closely to prevent a damaging porcupine population buildup within the area. Direct control of porcupine populations by trapping or poisoning may be necessary in this stand in the future. No northern pocket gopher (Thomomys talpoides) activity or damage has been noted in the stand.

During re-establishment of a new stand by natural regeneration from seed trees, the populations of the following rodents should be monitored: the Western red squirrel (Tamiasciurus hudsonicus), the northern pocket gopher, and the deer mouse (Peromyscus maniculatus). Appropriate direct control measures may be necessary if population levels of these species are high at critical periods.

Insects and Disease

Under the proposed schedule of cultural treatments and the past history of insect and diseases in the immediate vicinity of this stand there is no reason to expect major insect and disease problems in this stand during the rotation.[3] However, several insects have the potential for

---

[3] Personal communication with Steve Kohler, Division Entomologist, 1976.

causing limited mortality, growth reduction, shoot damage or cone damage and should be monitored for damaging population levels at appropriate times during stand development. (Keen (1952), and Schmidt, Shearer and Roe (1976)) These insects and areas of possible damage are presented in Table 7 below:

TABLE 7

MAJOR INSECT ENEMIES OF THE STAND

Insect	Area of Damage
Larch casebearer	Defoliation and growth reduction
Mountain pine beetle	Mortality
Red turpentine beetle (*Dendrotonus valens* Lec.)	Weakens trees
Western spruce budworm	Defoliation, severing terminal and lateral leaders, and cone and seed damage.
Larch sawfly (*Pristiphora erichsonii* Hartig)	Defoliation and mortality
Larch budmoth (*Zeiraphera griseana* Hubner)	Buds
Emarginate ips (*Ips emarginatus*)	Mortality
Western pine engraver (*Ips latidens*)	Mortality, top kill
Oregon pine engraver (*Ips oregoni* Eichh.)	Mortality, top kill

It is expected that the prescribed cultural treatments will remove the western larch dwarf mistletoe from the stand. During the life of the stand the following diseases presented in Table 8 may cause some generally minor damage to the stand. The possible presence of these diseases should be monitored and noted during stand examinations

TABLE 8

MAJOR FOREST DISEASES THAT MAY DAMAGE THE STAND

Disease	Area of Damage
Quinine fungus (Fomes officinalis Vill. ex Fr.)	Trunk rot
Red ring rot (Fomes pini Fr.(Karst)	Trunk rot
Shoestring rot (Armillaria mellea Fr. Quel.)	Root and butt rot
Yellow laminated root rot (Poria weirii Murr.)	Root and butt rot
Fomes annosus De. Cke	Root and buttrot
Velvet top fungus (Polyporus schweinitzii Fr.)	Root and butt rot
Hypodermella needle cast (Hypodermella laricis Tvb.)	Foilage disease
Meria needle cast (Meria laricis	Foliage disease
Cytospora abietis Sacc.	Stem canker
Phomopsis pseudotsuga M. M. Wilson	Stem canker

Atmospheric Agents

The prescribed treatment utilizes combinations of low and crown thinnings occurring at approximate 15 year intervals to provide for gradual opening of the stand and the development of wind firmness in the residual trees. The young stand of western larch, Douglasfir, ponderosa pine, and lodgepole pine, in the units immediately west of the stand that were harvested in the period 1966-1968 will provide a continuous canopy along the western stand boundary which should minimize windthrow along this windward edge of the stand. Removal of stand along both the northern and the southern boundaries of the stand will pre-dispose the stand to some minor degree of windthrow loss along these edges depending upon the date and type of stand removals planned in these stands. Some scattered windthrow can be expected during the managed life of the stand along the main Soup Creek Road and spur roads due to breaks in the canopy created by these roads. This is particularly true of those roads aligned in a west, south and southwest direction.

As has been mentioned previously, wind firmness is a critical consideration in the choice of seed trees left to regenerate the stand. Some loss of seed trees is to be expected on this area and provisions should be made to salvage seed tree losses as they occur.

CHAPTER VI

IMPACTS OF THE PRESCRIPTION

Under existing State Law and established administrative procedures, all Division actions are evaluated for environmental impact and a written impact statement prepared. Under the proposed prescription, a minimum of nine separate impact evaluations will be made during the managed life of the stand prior to each cultural treatment. These evaluations will serve to update and record the considerations of environmental impact through the life of the stand. This section attempts to describe and document the broad impacts that are expected to occur over the life of the prescription and again assumes natural regeneration of the stand by the seed tree regeneration method.

BIOLOGICAL AND ECOLOGICAL

Two reference points are necessary to evaluate the biological and ecological impacts of this prescription. These reference points are the pre-existing condition of the stand and the productive capability of the site to supply or optimize each resource value or use. Much of the data necessary to quantify these impacts is lacking for this specific stand, but whenever possible the general direction of change has been indicated. Evaluation of

impacts requires the application of certain value criteria which, unfortunately, tend to be highly variable between different observers. The viewpoint presented here has as much as possible, attempted to present an objective view of the resources changes that will occur under this prescription.

Vegetation

The existing stand replaces a pre-existing stand previously described in Chapter III which contained the same tree species, but was significantly different in species distribution age structure, and condition. The pre-existing stand was considered to be unmanageable in the sense of not having the ability to be transformed by a series of management treatments to yield those forest products and values which this site is capable of producing.

The new stand which has been initiated is both biologically and ecologically less diverse than the stand which preceeded it. With no further cultural treatments in the stand, biological diversity would increase through irregular natural mortality, but severe competition between remaining trees, shrubs, forbes, and grasses for available light, water, nutrients, and growing space will reduce the general health, vigor, and potential productivity of the stand. Maintaining more tree stems per acre than the

prescription will permit the inefficient allocation of wood fiber on the larger more desirable dominant and co-dominant trees. As a result, the average diameter and the volume of useable wood will be less than obtained under the prescription.

If the prescription was not implemented, the species composition of the stand would change with the number of ponderosa pine in the dominant and co-dominant class decreasing through overtopping and increasing root competition with the western larch. However, implementation of the prescription would discriminate against the slow growing generally more tolerant species such as Engelmann spruce, subalpine fir, and grand fir within the stand. Generally, these tree species would be removed in the series of prescribed low thinnings and would contribute to decreasing stand diversity over time.

Under the prescription the early successional stages of understory stands of shrubs, forbes, and grasses is expected to be prolonged due principally to the periodic thinnings which prevent permanent canopy closure. More light is expected to reach the forest floor throughout the life of the stand and those understory species favored by increased light will benefit at the expense of the more tolerant species.

After each stand entry, limbs, tops and other logging

debris will be deposited on the floor of the stand to naturally decompose. Burning of piled limbs and tops along roads and firebreaks will result in re-establishing small pockets of early successful stages of plant succession. Where mineral soil is exposed and light reaches the ground regeneration of intolerant tree species is expected. However, such regeneration is expected to be minor under the prescription and the prescribed low thinnings will periodically remove this regeneration.

During the regeneration of the stand by the seed tree regeneration method, logging slash and almost all understory plant species would be exposed to a bradcast burn which is expected to kill and consume the aerial portions of most species present. (Schmidt, Shearer and Roe 1976). Those understory species and their seed ecologically adapted to fire are expected to benefit and increase in both abundance and vigor. The existing species composition of the understory will be markedly changed due to the combined affects of overstory removal and the early successional changes initiated by burning.

Soil

The activities carried out in connection with the establishment of the existing stand have had a significant effect on the soil as described previously. The cultural

treatments which would be carried out under this prescription would generally be minor in nature. During stand entry, some compaction of the soil would occur in roads and skid trails and some limited soil movement would occur through rainsplash erosion and loss of fines from exposed soil and road surface. (Tackle, 1962)

The greatest impact on the soil would occur during the final harvest and regeneration of the area by the seed tree regeneration method. The protective canopy of overstory vegetation would be removed and the soil surface exposed to the action of atmospheric agencies (wind, water, sunlight). Prescribed burning is expected to remove the majority of the surface duff layer, and further expose the soil to the effects of runsplash erosion. The infiltration capacity of the soil is also expected to be lower than on undisturbed areas. (Tackle, 1962)

Following prescribed burning, the nutrient status of the soil is expected to change with the exchangeable calcium, potassium, and immediately available phosphorus and nitrogen increasing in the upper soil layers. During the period of vegetative recovery, only small losses of plant nutrients are expected to occur in overland flow and the small amount of sediment derived from this stand principally because the gentle slopes and infiltration capacity of the soil within the stand. (DeByle and Packer, 1972)

Water repellency of the soil after prescribed burning is not expected to be a problem on this soil. (DeByle 1973) No excessive nutrient loss that reduces the productive capacity of the site is expected to occur. (DeByle and Packer, 1972)

Wildlife and Domestic Animals

Big game cover within the stand will be reduced over that available if the stand is allowed to develop without cultural treatments due to periodic low thinnings. Snow depths within the stand are expected to increase due to reduced canopy closure and in forested grasses and forbes and increased ease of animal movement within the interior of the stand.

Watershed

The water yield from this prescription is expected to be greater than under unmanaged conditions due to reduced canopy closure throughout the rotation. When complete canopy closure occurs, the estimated existing water yield of 105.5 acre feet (for 50% cover canopy) of runoff will be reduced to 85.2 acre feet. During the prescription period, the annual water yield will fluctuate depending upon the actual canopy coverage which is present and the yearly precipitation events which have occurred. However, assuming an average canopy coverage of 70% over the

remaining life of the stand, an average annual water increase of 26.0 acre feet per year runoff can be expected. Assuming complete canopy removal at the time of removal of the seed trees a maximum increase of water yield of 37.1 acre feet can be expected from the stand.

The impact of this increased water yield is expected to be negligible as the majority of this increase would be removed by sub-surface drainage. However, the effect of this increase at some future date on Soup Creek is not presently known. The future condition of stream and other future managment (or wildfire events) will have to be evaluated at the time of the planned future harvest.

The increased release of nutrients as a result of prescribed burning are expected to add a minute amount of nutrients to Soup Creek. This small nutrient increase though unquantified is not expected to be a hazard to water quality based on other studies in western Montana (DeByle and Packer, 1972)

SOCIAL

It is the intent of this prescription to manage this stand throughout its life as a managed forest stand with the production of forest products as its principle objective. In addition to forest products, jobs, recreation, and pleasing aesthetic experiences are expected to accrue to the people

that visit, work in, or view this stand. Over the life of the stand, man's activities will be noticeable in varying degrees at various times and impact the visitors to the stand in a variety of ways depending upon complex attitudes, experiences, and other behavioral factors. Overall, it is expected that the treatments prescribed and the resulting social impacts for this stand will be acceptable to the majority of forest users.

FOREST PRODUCT YIELDS

Implementation of this prescription will have a significant positive impact on the type, quantity, and quality of useful forest products that can be obtained from the stand. This young stand can be molded by a variety of cultural treatments to yield a wide variety of forest products over time. However, at this early stage in stand development, the paramount considerations are to place the stand in a healthy and productive condition for latter cultural treatments aimed at producing specific forest products.

This prescription is designed to manage the stand in accordance with Table 6 found in the "Intermediate Cutting Guide for the Western Larch Type". (Anonymous, 1973) This

management table is based upon leaving 45% of normal basal area for trees 12" or larger. A graphical representation of this data for site index 70 and other relevant data from management tables 1, 2, 3, and 6 (The Management of Western Larch: Northern Region, Anonymous 1973) is presented in Figure 3. The assumptions are made by the author that the data and equations on which these tables are based are reasonable, that the prescribed series of stand entries will allow the potential crop trees to grow at or close to their full potential, and that essentially all mortality occurring during the period will be removed at each stand entry under the prescription.

The forest product yields are expected to be principally studlogs, sawlogs, peeler logs and poles, but over time other forest product yields may be realized. Under the prescription an estimated average of 10,223 cubic feet per acre of wood would be obtained from the managed stand over the 110 year rotation. Cubic foot yields from an unmanaged stand would vary depending principally upon the degree to which the stand approached or exceeded normal stocking.[1]

---

[1] Normal stocking is the degree of stocking given in normal yield tables. For site index 70 normal stocking is 271 trees per acre or 274 square feet of basal area.

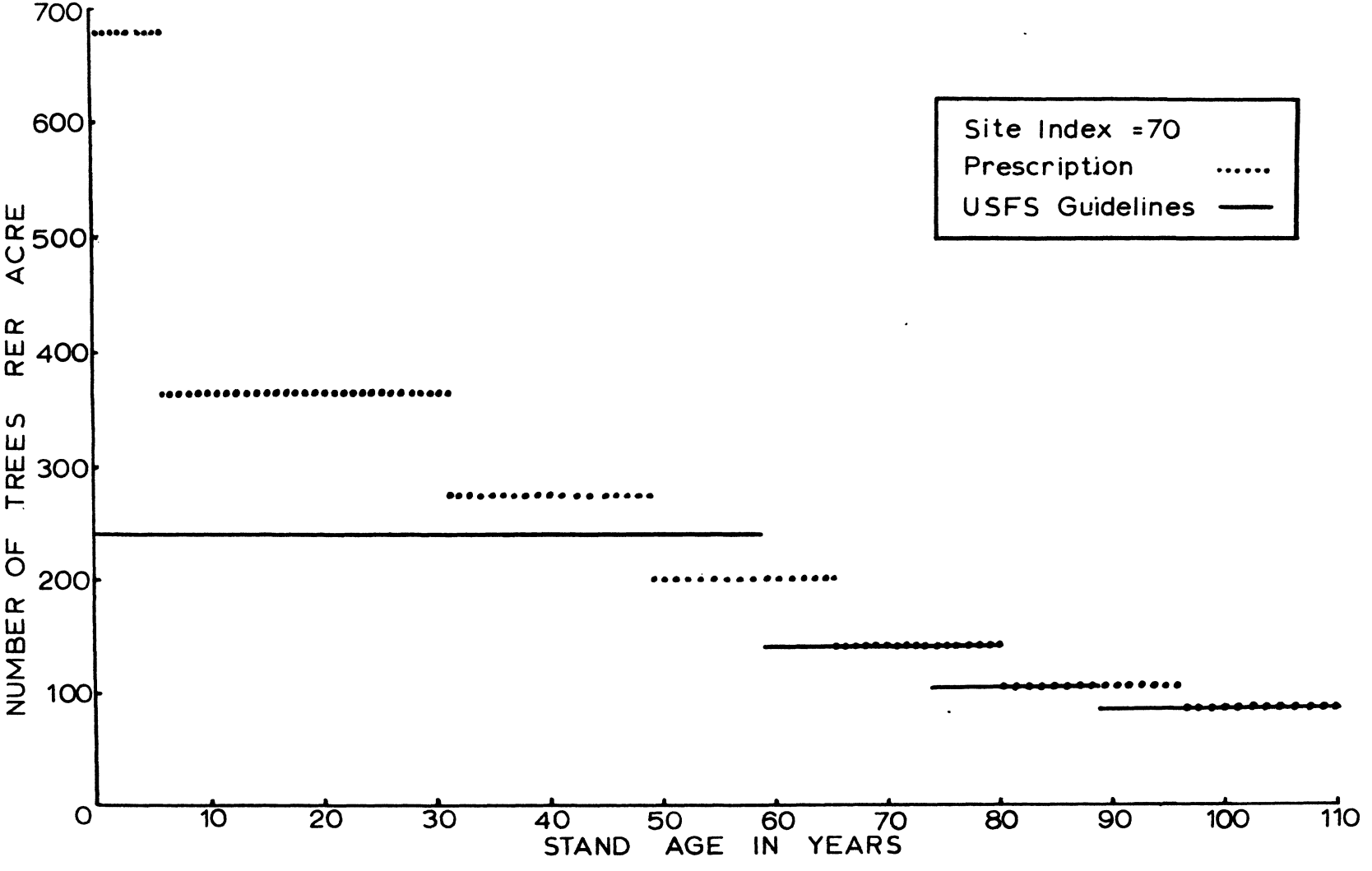

Figure 3 Comparison of the prescribed thinning schedule with the U.S. Forest Service guidelines for the management of western larch.

Table 9 presents estimates of the cubic foot volume produced by the stand at a rotation age of 110 years utilizing the data of Schmidt, Shearer and Roe (1976) and the regional supplement entitled "Management of Western Larch--Northern Region " (Anonymous 1973)

TABLE 9

ESTIMATED YIELDS FROM THE STAND AT VARIOUS DEGREES OF STOCKING

Normal Stocking in Percent	Average Stand Dia. in inches	Trees/ Acre	Basal Area in Sq. Ft.	Volume/Acre in Cubic Foot
60	15.4"	127	164.4	5,511
100	13.6"	271	274.0	8,030
140	11.8"	479	383.6	9,772

The estimates presented in Table 9 give an indication of possible yields without management or investment during the rotation. However, it must be remembered that they represent very optimistic estimates of possible yield because they assume that stocking adjustments will occur in an orderly fashion at an early age, that the best trees will always be favored and that the stresses imposed on the stand will not presuppose the stand damaging agencies or organisms resulting in increased mortality among crop trees. These are clearly unreasonable assumptions in making projections of unmanaged stand development and yield over a period of 110 years.

During November 1975, nine stand projections using Al Stage's Growth Prognosis Model (Stage, 1973) were run using the computer program at the University of Idaho at Moscow. Two of these projections assumed that the stand had been thinned to 320 stems/acre in 1980 (approximate 11.7' x 11.7' spacing) which closely approximates the 360 trees per acre residual (approximate 11 x 11 spacing) called for in this prescription. However, the results of these computer simulations were considered unuseable because the controlling equations in the model at that time were not capable of making accurately projections for trees from one to five inches initial d.b.h. A second and more serious problem with these projections was that excessive natural mortality appeared to be occurring in the model. For example, in the projection which provides for no further thinnings over the rotation, the stand had only 30 trees per acre stocking at 110 years although no trees were cut from the stand.

The second projection reduced stocking by a thinning in 1990 (stand age 24) to 200 trees per acre which is very close to the existing regional intermediate cutting guidelines for this stand which call for a desirable stocking of 237 trees per acre when trees are between 0 and 10 inches in diameter. This projection appears to be more reasonable with 65 trees per acre remaining at stand age 110, but yield

estimates were still unreasonably low. Examination of the individual tree records showed that problems appeared to result from incorrect coefficients being generated for the growth equations in the model. For example, the model projected a 10.3" diameter ponderosa pine with height of 151.6' and a 3.4" diameter western larch with a height of 80.5' at 2080.

For the stand as a whole the prescription is expected to yield the cubic foot volume yields presented in Table 10. The specific impact of these yields will have to be determined at those specific points of time.

ECONOMIC

The economic impacts of the prescription are expected to be beneficial by providing income to school trust, jobs, personal and corporate income, and products which are of utility and of value to man. These favorable economic impacts are expected to occur principally, locally and within the State of Montana. Given the nature of money which can be invested in alternative uses it is reasonable to evaluate the financial impact of investing money (and the treatments that it can buy) against the costs and returns over time to determine in the economic sense of whether a task or series of tasks is worth doing.

The following economic analysis has been made on this

TABLE 10

ESTIMATED TOTAL CUBIC FOOT YIELD OF WOOD DURING THE PRESCRIPTION PERIOD

Year	Stand Age in Years	Areas Within the Stand 1a	1b	2	Total Yield in Cubic Feet[1]
1976	10	--	--	--	--
1977	11	--	--	--	--
1982	16	--	--	--	--
1987	21	--	--	--	--
1997	31	10,555	4,637	9,792	24,984
2015	49	70,808	31,105	27,048	128,961
2031	65	95,437	41,924	36,456	173,817
2046	80	88,546	38,898	38,535	165,979
2062	96	71,834	31,556	31,262	134,652
2076	110	414,145	181,930	180,235	776,310
Total Yield		751,325	330,050	323,328	1,404,703
Average Yield Per Acre					10,223

[1]Yield shown here is an estimate of potential gross yield only. No cull, breakage, or other loss has been considered.

prescription on a per acre basis. The papers by Lundgren (1973) and Beuter (1971) discuss the many problems present in making economic analyses to evaluate alternative investments in cultural treatments. It is the author's own belief that such analyses to project specific returns from a stand such as this over time should not be used alone to determine investment decisions. As a practical matter, the need and justification to prepare specific economic analyses on individual stands appears of questionable value in most stand management situations.

In the economic analyses for present value of expected costs and benefits presented in Table 11 on the following page, the per acre cost is calculated only for an acre which has received all entries. An example of such an acre in the stand would be those acres of Areas 1a, 1b or 2 receiving the special treatment for dwarf mistletoe removal. The interest rate of 6% was chosen to represent a reasonable rate of return over the period and no other land holding costs, fire protection costs, or special management costs such as forest survey, road maintenance, etc., were included. The analysis was also run using a 4% interest rate to give additional insight into the effect of the interest rate chosen on the present value of the treatment. No significant long-term adverse economic impacts of implementing this prescription have been identified.

TABLE 11

YIELDS, COSTS, INCOME, AND PRESENT VALUES OF THE PRESCRIPTION FOR AN ACRE RECEIVING ALL TREATMENTS

Year	Stand Age in Years	Years From 1976	Yield in[1] Board Feet	Management[2] Costs in Dollars	Income in[3] Dollars	Net Income In Dollars
1976	10	0	--	--	--	--
1977	11	1	--	-16.00	--	-16.00
1982	16	6	--	-15.00	--	-15.00
1987	21	11	--	-16.00	--	-16.00
1997	31	21	570	-7.00	+11.40	+4.40
2015	49	39	4,126	-11.50	+123.78	+112.28
2031	65	55	5,940	-11.00	+233.43	+222.43
2046	80	70	5,810	-10.50	+261.45	+250.95
2062	96	86	5,020	-10.00	+276.10	+266.10
2076	110	100	30,430	-12.50	+2,130.10	+2,117.60
Totals			51,896	-109.50	+3,036.26	+2,973.76
Present Value at 6% Interest Rate						+.40
Present Value at 4% Interest Rate						+81.53

[1]No loss to rot, breakage, or handling loss is assumed here.
[2]Thinning, marking, and timber sale preparation costs are only costs charged here.
[3]Stumpage value only based on diameter at dbh and converted to cubic feet using equations of Adams and Allen (1974); 6"=$20.00/MBF, 10"=$30.00/MBF, 12"=$35.00/MBF, 14"=$45.00/MBF, 16"=$55.00/MBF, and 18"=$70.00/MBF.

CHAPTER VII

CONCLUSION

This management prescription prepared for the Napa Special Management Unit has demonstrated that the preparation of detailed prescriptions is a desirable practice to guide short and long-term management efforts on State Forest Lands.

On a daily operational basis it is anticipated that very few written prescriptions will be as detailed as this prescription due to the lack of time, manpower and funding. However, it is anticipated that all of the considerations embodied in this prescription will be made and recorded to provide ongoing management direction.

To determine the utility of the prescriptive technique, copies of this prescription were circulated within the Division of Forestry for review and comment. As a result of this review, the prescriptive technique is presently being incorporated into the Division's Forest Management procedures.

LITERATURE CITED

1. Adams, D.L. and G.M. Allen 1974 "Lumber Production from 'Precommercial' Thinnings in Northern Idaho". University of Idaho. Station Paper No. 16. 11p

2. Alexander, R.R. and F.G. Hawksworth 1975. "Wildland Fires and Dwarf Mistletoes: A Literature Review of Ecology and Prescribed Burning". USDA Forest Service. General Technical Report. RM-14 12p.

3. Allen, G.M., D.L. Adams, and C.R. Prausa. 1974. "Preliminary Volume Tables for Small Trees in Northern Idaho". University of Idaho. Station Note. No. 21.3p.

4. Anonymous. 1973 "Management of Western Larch: Northern Region". "Regional Supplement to the Forest Service Handbook". USDA Forest Service, Missoula, Montana 102p.

5. Barrett, J.W. 1971. "Ponderosa Pine Growth and Stand Management". Paper presented at the symposium of Precommercial Thinning of Coastal and Intermountain Forests in the Pacific Northwest held February 3-4, 1971 at Washington State University.

6. Beuter, J.H. 1971. Timber VAlue--"A Matter of Choice". USDA Forest Service Pacific Northwest Forest and Range Experiment Station Research Paper, PNW-118, 12p.

7. DeByle, N.V. 1973. "Broadcast Burning of Logging Residues and the Water Repellency of Soils". Northwest Science, Vo. 47, No. 2: 77-87.

8. DeByle, N.V. and P.E. Packer. 1972. "Plant Nutrient and Soil Losses in Overland Flow from Burned Forest Clearcuts". National Symposium on Watersheds in Transition.

9. Foiles, M.W. and J.D. Curtis. 1973. "Regeneration of Ponderosa Pine in the Northern Rocky Mountain and Intermountain Region". USDA Forest Service, Intermountain Forest and RAnge Experimental Station Research Paper INT-145. 44p.

10. Hawksworth, F.G. and D. Wiens. 1972. "Biology and Classification of Dwarf Mistletoes (Arceuthobium)". USDA Agricultural Handbook No. 401. 234p.

11. Hermann, R.K. 1970. "Regeneration of Ponderosa Pine." Proceeding of a symposium held September 11-12, 1969 held at the School of Forestry, Oregon State University at Corvallis, Oregon. 125p.

12. Hibbert, A.R. 1966. "Forest Treatment Effects on Water Yield". Paper presented at the International Symposium on Forest Hydrology. Proceedings of a National Science Foundation Advanced Seminar held at the Pennsylvania State University, August 29-September 10, 1965. Pergamon Press, Oxford and New York. pp. 527-543

13. Holbrook, H.L. 1973. "A System for Wildlife Habitat Management on Southern National Forests". Wildlife Society Bulletin. Vol. 2, No. 3: 119-123.

14. Howe, G.E. 1973. "The Forest Genetics Program for the Northern Region" USDA, Forest Service, Region 1, R1-74-007. 92 p.

15. Keen, F.P. 1952. "Insect Enemies of Western Forests". USDA, Misc. Pub. No. 273. 280p.

16. Libby, W.J., etal. 1968. "Biological Methods of Securing Genetic Gains in Forest Trees". 1970 revision prepared for the conference on artificial regeneration for multiple-use forest management. 19p.

17. Libby, W.J. 1973. "Domestication Strategies for Forest Trees". Canadian Journal of Forest Research. Vol. 3 No. 2: 265-276

18. Libby, W.J. 1974. "The Use of VEgetative Propagules in Forest Genetics and Tree Improvement". New Zealand Journal of Forest Science. 4(2): 440-447

19. Lundgren, A.L. 1971. "Tables of Compound Discount Interest Rate Multipliers for Evaluating Forestry Investments". USDA, Forest Service. North Central Forest and RAnge Experimental Station. Research Paper NC-51. 142p.

20. Lundgren, A.L. 1973. Cost Price: "A Useful Way to Evaluate Timber Growing Alternatives". USDA, Forest Service. North Central Forest and Range Experimental Station. Research Paper NC-95. 16p.

21. Lynch, D.W. 1954. "Growth of Young Ponderosa Pine Stands in the Inland Empire". USDA, Forest Service. Intermountain Forest and Range Experimental Station Research Paper No. 36. 16p.

22. Lynch, D.W. 1958. "Effects of Stocking on Site Measurement and Yield of Second Growth Ponderosa Pine in the Inland Empire". USDA, Forest Service. Intermountain Forest and Range Experimental Station. Research Paper No. 56. 36p.

23. McClelland, B.R. and S.F. Frissell. 1975. "Identifying Forest Snags Useful for Hole Nesting Birds". Journal of Forestry. 73(6): 414-417.

24. Mussehl, T.W. and F.W. Howell. 1971. "Game Management in Montana". Special publication of the Montana Fish and Game under Federal Aid Project W-3C. 238p.

25. Pfister, R.D., S.F. Arno, B.L. Kovalchik, and K.C. Presby. 1974. "Forest Habitat Types of Montana". A review draft of proposed Intermountain Forest and Range Experimental Station Research Paper. 214p.

26. Rice, R.M., J.S. Rothacher and W.F. Megahan. 1972. "Erosional Consequences of Timber Harvesting: An Appraisal". National Symposium on Watersheds in Transition: 321-329

27. Schmidt, W.C., R.C. Shearer, and A.L. Roe. 1976. "Ecology and Silviculture of Western Larch Forests". USDA, Forest Service, Technical Bulletin No. 1520. 96p.

28. Shearer, R.C. 1971. "Silvicultural Systems in Western Larch Forests". Journal of Forestry. 69 (10): 732-735.

29. Siderits, K. 1975. "Forest Diversity: An Approach to Wildlife Management". The Forestry Chronicle. Vol. 51. No. 3; 1-5.

30. Smith, D.M. 1962. "The Practice of Silviculture". Seventh Edition. John Wiley and Sons., Inc., New York. 578p.

31. Stage, A.R. 1973. "Prognosis Model for Stand Development". USDA, Forest Service, Intermountain Forest and Range Experimental Station. Research Paper, INT-137, 32p.

32. Tackle, D. 1962. "Infiltration in a Western Larch--Douglasfir Stand Following Cutting and Slash Treatment". USDA, Forest Service, Intermountain Forest and Range Experimental Station. Research Note No. 89. 7p.

33. Wickstrom, J.H. and C.A. Wellner. 1961. "The Opportunity to Thin and Prune in the Northern Rocky Mountain and Intermountain Regions". USDA, Forest Service, Intermountain Forest and Range Experimental Station. Research Paper 61. 14p.